BERESIC, NICHOLAS J., Ed.D. Examining Low Back Pain Prevention Strategies in the Electrophysiology and Catheterization Lab. (2019)
Directed by Dr. Pamela Kocher Brown. 48 pp.

The purpose of this study was to examine the role of exercise and physical activity routines, health education, and continued management support as low back pain prevention strategies in the electrophysiology and catheterization lab (EP/Cath lab) community. To determine whether those individuals who completed more low back pain prevention strategies experience less musculoskeletal symptoms than those individuals who completed fewer, if any, prevention strategies, a survey was administered to two groups of EP/Cath lab professionals. A total of 26 completed surveys were included in the final data set. Low back pain was the most prevalent musculoskeletal symptom recorded, both in terms of trouble in the past 12 months (57.69%) and trouble in the past seven days (19.23%). Furthermore, data trends showed an increase in the prevalence of low back pain as the number of years working in an EP/Cath lab setting increased. Results of an independent t-test indicated that those individuals with low back pain completed more prevention strategies (M=5.8, SD=3.6) than those individuals without low back pain (M=4.9, SD=2.5), but the mean difference was not significant, t(24)=.70, p=.49, d=.28. Finally, a Pearson correlation revealed no significant relationship between the number of prevention strategies completed and the Nordic Musculoskeletal Questionnaire number of “Yes” responses, r(24)=-.013, p=.95. As the number of prevention strategies completed was not found to be a predictor of injury, the identification and surveying of EP/Cath lab professionals who regularly complete a relatively high number of prevention strategies is suggested for future research to determine the best course of action to pursue to address musculoskeletal symptoms.

EXAMINING LOW BACK PAIN PREVENTION STRATEGIES IN THE ELECTROPHYSIOLOGY AND CATHETERIZATION LAB

by

Nicholas J. Beresic

A Dissertation Submitted to
the Faculty of The Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Doctor of Education

Greensboro
2019

Approved by

_____
Committee Chair

I dedicate this work to my wife, Amanda Beresic, whom without her love, support, and encouragement, I would have never been able to accomplish my dream of earning a doctorate.

APPROVAL PAGE

This dissertation written by Nicholas J. Beresic has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

Committee Chair_____
Dr. Pamela Kocher Brown

Committee Members_____
Dr. William Karper

_____
Dr. Diane Gill

_____
Date of Acceptance by Committee

_____
Date of Final Oral Examination

ACKNOWLEDGEMENTS

I would like to acknowledge that this project would not have been possible without the support of the following people: Dr. Pamela Kocher Brown, Dr. William Karper, Dr. Diane Gill, Dr. Jeffrey Labban, Carol Epling, M.D., Rick Stouffer, M.D., William Abernethy, M.D., Brenda McClure, R.N., and Beth Denny.

TABLE OF CONTENTS

LIST OF TABLES

Page

CHAPTER I

PROJECT OVERVIEW

Musculoskeletal disorders, such as low back pain, are a common, costly problem in the hospital workforce. This is due to the regular lifting, positioning, and transporting of patients, fast pace work environment, and a general collective temperament of putting their patient's health before their own. Those employees who work in a hospital's EP/Cath lab appear to be especially susceptible to injury. EP/Cath lab professionals regularly maintain forward-flexed postures for extended periods of time while working in the operating room. In comparison to an acute injury such as a fall or collision, their collective back pain develops slowly over time until the pain becomes chronic and affects their lives both inside and outside of the hospital. Traditionally exercise and physical activity routines, health education, and continued management support have been promoted as low cost/low risk interventions to address low back pain, but the extent to which hospital policy and culture enable these prevention strategies to be completed is unknown. Thus, this study explored the perceived effectiveness of these investments in wellness from the perspective of the EP/Cath lab professional.

Significance

Low back pain and other musculoskeletal disorders are a common occurrence with substantial cost and impact on the United States economy (Katz, 2006). Musculoskeletal disorders account for 34% of all lost-workday injuries and illnesses and $1 of every $3 spent on workers' compensation costs (Occupational Safety

and Health Administration [OSHA], 2014). Additionally, the indirect costs of low back pain and other musculoskeletal disorders include $59 billion per year in productivity loss (Spine Research Institute, 2014). Such growing costs to businesses underscores the growing interest in, and significance of, cost-effective programs which are powerful enough to improve the health of the workforce, yet also produce a positive return on investment (Goetzel, Roemer, Liss-Levinson, & Samoly, 2008). As a way to address this situation, noninvasive interventions including staff trainings on postural awareness and the completion of regular physical activity have been promoted as effective treatments for low back pain, but the evidence of their effectiveness is limited (Qaseem, Wilt, McLean, Forciea, & Clinical Guidelines Committee of the American College of Physicians, 2017). This study was, therefore, potentially highly significant because its successful completion was expected to provide evidence showing the low cost/low risk combination of exercise and physical activity routines, health education, and continued management support were correlated to a reduced prevalence of low back pain. The findings are needed to advocate businesses to make the social, financial, and strategic investments necessary to realize significant and lasting reductions in musculoskeletal injuries in their workforce (Gartley & Prosser, 2011). Once these investments have been made and are accepted as part of the workplace culture, collective reductions in the incidence, degree, and consequence of human physical pain may finally be realized.

Relevant Literature

Musculoskeletal disorders are cumulative, chronic, and slow developing injuries to the soft tissues of the body (University of Massachusetts Lowell, 2011). Musculoskeletal disorders have a significant financial impact on businesses and the workforce including 34% of all lost-workday injuries and illnesses and $1 of every $3

spent on workers' compensation costs (OSHA, 2014). To compound this problem, one in five workers who report a musculoskeletal disorder is unable to return to work within a month, costing their employers additional money, time, and resources to hire and train temporary staff (Spine Research Institute, 2014). Due to the high direct and indirect costs to businesses, exploring ways to reduce musculoskeletal disorders is a key strategic target of employers.

Hospital workers are highly susceptible to musculoskeletal disorders due to the regular lifting, positioning, and transporting of patients, combined with a fast pace work environment and a general collective temperament of putting their patients' health before their own (OSHA, 2013). Upon closer review, the EP/Cath lab subset of the hospital workforce appears to be especially susceptible to the specific musculoskeletal disorder of low back pain due to the sustained forward-flexed postures they commonly maintain while working in the operating room (Johnson, 2012). Current EP/Cath lab norms suggest increases in the length and volume of caseload procedures are proportionally increasing the number of work hours in which EP/Cath lab professionals are required to stand in ergonomically-taxing work positions (O'Riordan, 2005).

As a strategy to address this dilemma, exercise and physical activity routines, health education, and continued management support have been broadly promoted as cost-effective programs which are powerful enough to improve the health of the workforce, yet also produce a positive return on investment (Goetzel et al., 2008). In theory the implementation of these low cost/low risk programs is a sound strategy based on evidence-based guidelines. The American College of Physicians strongly recommends nonpharmacologic treatments for chronic low back pain, including exercise and mindfulness-based stress reduction, because the benefits clearly outweigh the risks

(Qaseem et al., 2017). Bergeron, Wright, and Killion (2006) sought to identify the treatments currently used by Radiologic Technologists for low back pain and the frequency of use of such treatments. "Exercise/stretching" was the only nonpharmacologic treatment option listed which could be completed independently and without the hired services of a licensed professional. In practice, limited time and the inability to incorporate the program into everyday work routines have been found to be the two main reasons why these worksite-based fitness programs have failed to produce significant findings (Christenssen, 2001).

To overcome these barriers, hospital management must concurrently have the social, financial, and strategic investments in place which complement and support these specific wellness interventions to realize significant and lasting reductions in musculoskeletal disorders (Gartley & Prosser, 2011). Unfortunately, the extent to which these investments have been made by hospital management, and thus perceived effective by the EP/Cath lab workforce, is unknown.

A holistic study of musculoskeletal symptoms was warranted because a close association exists between the presence of pain in various regions of the body and the likelihood of developing new back pain (Waddell, 2004, p. 76). In terms of injury prevention, the health of the back cannot be separated from the health of the body. This study sought to determine whether those individuals who completed more low back pain prevention strategies experience less musculoskeletal symptoms than those individuals who completed fewer, if any, prevention strategies. Considerable published support for this theory was amassed during the review of the following low back pain prevention "best practices."

First, as a means by which to provide consistent program oversight and address the high program dropout rates documented in independent programs, a facilitator-led class should be offered daily to the EP/Cath lab team (Smith, 2013). In following the Back School protocol, these classes need to have both a physical activity component and an educational component in order for the results to be successful and long-lasting (Jaromi, Nemeth, Kranicz, Laczko, & Betlehem, 2012). The physical activity component needs to be comprised of both stretching and strengthening exercises, as well as exercises which are performed independently a minimum of five times per week (Jaromi et al., 2012) for a period of 20-60 minutes per session (Freimann, Merisalu, & Paasuke, 2015). When combined with the weekly facilitator-led class, these exercise recommendations are aligned with the Physical Activity Guidelines for adults of completing at least 150 minutes per week of moderate-intensity aerobic physical activity along with two or more days/week of strength training (Office of Disease Prevention and Health Promotion, 2018a).

Next, short educational talks should be provided to the entire EP/Cath Lab team on work time during one of their weekly mandatory meetings (Smith, 2013). This strategy permits those EP/Cath lab employees who are uninterested in participating the optional physical activity component to at least receive pertinent educational information on posture (Christman, Fan, Fiszer, & Hunt, 2013) and stress management (Waddell, 2004, p. 232).

Once done, continued management support needs to be maintained throughout the entirety of the program in the form of shared overarching goals (Comelli, Vignali, Rolli, Lippi, & Cervellin, 2012), periodic evaluation (Wheeler, 2015), and listening to the

needs of the employees, addressing their specific issues, and most importantly following through with what has been promised (Crawford, Neil, & Thomas, 2014).

Purpose and Specific Aims

The purpose of this study was to examine the role of exercise and physical activity routines, health education, and continued management support as low back pain prevention strategies in the EP/Cath lab community. Several previous studies of EP/Cath lab professionals examined the relationship between demographics/applicable work practice details and musculoskeletal symptoms, but a gap in the literature was present regarding the number and type of low back pain prevention strategies most regularly completed by those included in the studies (Klein et al, 2009). Upon successful completion of the study, the primary investigator (PI) expected to have compiled the number and type of low back pain prevention strategies most regularly completed by those EP/Cath lab professionals who reported the least amount of musculoskeletal symptoms.

There is a clear need to develop cost-efficient interventions to address the common, costly problem of musculoskeletal disorders in the EP/Cath lab community. This study is, therefore, potentially significant because its successful completion was expected to provide evidence showing the low cost/low risk combination of exercise and physical activity routines, health education, and continued management support were correlated to a reduced prevalence of low back pain.

Specific Aim #1: Determine the prevalence of low back pain and other musculoskeletal symptoms within the EP/Cath lab community.

Specific Aim #2: Determine the current use of prevention strategies within the EP/Cath lab community.

Specific Aim #3: Examine the relationship between the completion of prevention strategies and the prevalence of low back pain and musculoskeletal symptoms.

Methods

Selection and Recruitment of Study Participants

Those individuals who work in either an EP or Cath lab setting were eligible to participate in the study. According to the Bureau of Labor Statistics (2018), 1,130 Cardiovascular Technologists and Technicians are currently employed in the state of North Carolina. To obtain a representative sample of study participants who are physicians, the 650-member North Carolina chapter of the American College of Cardiology (ACC) was contacted for assistance with the study. Assistance included the permitted attendance of an annual chapter meeting. Additionally, the University of North Carolina (UNC) School of Medicine internal email list of 53 EP/Cath lab managers and technicians was used to obtain a sample of study participants who represented hospital management and staff. A sample size of 85 study participants (n=85) was needed to detect a moderate correlation (r=0.3) using a two-tailed test (α=0.05) with 80% power (β=0.2).

Data Collection

A convenience sample design was used and all survey research data were collected through the administration of a validated Qualtrics survey. The survey targeted EP/Cath lab physicians, managers, and technicians and included questions to assess exercise and physical activity routines, health education, and continued management support. No personally identifiable information was collected during the administration of the survey. Research data was collected on two populations of EP/Cath lab physicians, managers and technicians.

UNC School of Medicine Data Collection. The Chief of Cardiology at the UNC School of Medicine granted the PI permission to use his internal email distribution list of 53 EP/Cath lab managers and technicians to solicit the Qualtrics survey. Once UNCG IRB approval was obtained and shared with the UNC IRB, the PI proceeded to email the survey to this specific list of hospital management and staff. Approximately four weeks later a second email was sent to ensure maximum participation in the study.

ACC Data Collection. The North Carolina Chapter of the ACC granted the PI a Letter of Support for the permitted attendance of the 2018 NC & SC Chapters ACC Annual Joint Meeting for research purposes. Approximately 200 conference attendants had the opportunity to complete the survey in electronic format. The PI brought eight iPads to the three-day event, with the Qualtrics survey hyperlink saved in the frequently visited section of Safari for easy accessing. All survey responses were collected anonymously, de-identified for analysis purposes, and stored in the UNCG Box account of the PI. Accessibility to this UNCG Box account was limited to only the PI and Faculty Advisor. Statistical analysis was carried out using the program Microsoft Excel.

Data Instrumentation

The survey was designed specifically for this research using the Qualtrics surveying software program. The survey included three general sections: Nordic Musculoskeletal Questionnaire (NMQ), demographics/applicable work practice details, and low back pain prevention strategies. The first section featuring the NMQ was used to calculate the prevalence of musculoskeletal symptoms within the EP/Cath lab employee population. The NMQ was developed for the analysis of musculoskeletal symptoms (Kuorinka et al., 1987) and has been validated and applied to a wide range of occupational groups, including nursing (Crawford, 2007). Additionally, the validity and

reliability of the NMQ was assessed to be moderate to high and its use appropriate for epidemiological research related to musculoskeletal disorders (Lenderink & Zoer, 2012). As the NMQ was designed for administration via paper-based survey, the full-body image used to identify the nine regions of the body was cropped into nine part-specific images to provide the research participant a constant visual reference during the completion of the electronic-based NMQ. The second section on demographics/applicable work practice assessed height, weight, gender, age, number of years worked in an EP/Cath lab setting, number of hours per week in a lead apron, and percentage of average shift spent standing. The third section on low back pain prevention strategies assessed exercise and physical activity routines, health education, and continued management support. These questions were developed through the examination of peer-reviewed journal articles, scientific posters, and government websites which promote specific behaviors or actions that had the potential to prevent or reduce low back pain.

Results

A total of 38 completed surveys were collected in this study, of which 14 were collected through the UNC School of Medicine internal email list and 24 were collected at the 2018 ACC Annual Chapter Meeting. To limit the study to only EP and Cath lab professionals, nine individuals who recorded a response of zero to the survey question "number of years worked in an EP/Cath lab setting" were omitted from the final data set. Additionally, three individuals did not complete the survey in its entirety and thus, were omitted from the final data set. Ultimately, a total of 26 completed surveys were included in the final data set for analysis.

First, musculoskeletal symptoms were summarized through descriptive statistics. Table 1 summarizes the prevalence of aches, pains, discomfort, and/or numbness reported in each of the nine regions of the body as referenced in the NMQ.

Table 1

Nordic Musculoskeletal Questionnaire Number of "Yes" Responses

Region of Body	"Yes" Response (n=26)
Neck	46.15%
Trouble in the last 12 months	12
Prevented from normal work	4
Trouble in the last 7 days	2
Shoulders	42.31%
Trouble in the last 12 months	11
Prevented from normal work	2
Trouble in the last 7 days	1
Elbows	0.00%
Trouble in the last 12 months	0
Prevented from normal work	0
Trouble in the last 7 days	0
Wrists/Hands	23.08%
Trouble in the last 12 months	6
Prevented from normal work	3
Trouble in the last 7 days	1
Upper Back	30.77%
Trouble in the last 12 months	8
Prevented from normal work	2
Trouble in the last 7 days	3
Lower Back	57.69%
Trouble in the last 12 months	15
Prevented from normal work	3
Trouble in the last 7 days	5
Hips/Thighs	11.54%
Trouble in the last 12 months	3
Prevented from normal work	1
Trouble in the last 7 days	1
Knees	23.08%
Trouble in the last 12 months	6
Prevented from normal work	0
Trouble in the last 7 days	2

Table 1 (continued)

Feet/Ankles	23.08%
Trouble in the last 12 months	6
Prevented from normal work	2
Trouble in the last 7 days	3
Per Person Mean and SD	3.92±3.02

Following the protocol of the NMQ, three descriptive questions were used to determine the prevalence of musculoskeletal symptoms in the nine regions of the body. Low back pain was the most prevalent musculoskeletal symptom recorded, both in terms of trouble in the past 12 months (57.69%) and trouble in the past seven days (19.23%). When the total number of "Yes" responses on the NMQ was analyzed per person, the data showed a wide range of musculoskeletal symptoms were present in the study population (M=3.92 SD=3.02). Regarding the endpoints of this range, two individuals recorded zero "Yes" responses related to the presence of musculoskeletal symptoms and one individual recorded a total of 12 "Yes" responses between the three descriptive questions.

Next, demographic and applicable work practices were calculated through descriptive statistics. This included height, weight, gender, age, number of years working in an EP/Cath lab setting, number of hours per week in a lead apron, and percentage of average shift spent standing (Table 2).

Table 2

Demographics/Applicable Work Practice Details Stratified by the Presence or Absence of Low Back Pain (LBP)

Variable	Total	LBP	No LBP
Number	26	15	11
Height (inches)	63.23±3.40	67.53±3.07	69.18±3.74
Weight (pounds)	180.65±36.86	182.27±46.06	178.45±20.45
Gender (% male)	53.85	40.00	72.73
Age	44.71±9.54	45.87±10.28	42.78±8.36
Years working in EP/Cath lab setting	12.88±13.69	13.2±10.40	12.45±17.80
0-4	8	4	4
5-10	8	4	4
11-16	3	2	1
17-20	3	2	1
21 or more	4	3	1
Hours per week in lead apron	10.98±12.70	10.03±13.58	12.27±11.91
% of shift spent standing in lab	52.91±24.84	52.25±21.77	53.70±29.31

Table 2 showed females tended to report more low back pain while males tended to report less back pain, even though the study population was almost evenly split between the genders. Furthermore, Table 2 stratified study participants by relative range of years employed in an EP/Cath lab setting. Data trends showed an increase in the prevalence of low back pain as the number of years working in an EP/Cath lab setting increased.

Once done, data documenting the completion of prevention strategies were stratified by the presence/absence of low back pain and analyzed through descriptive statistics. Table 3 summarized the totals related to each low back pain prevention strategy completed.

Table 3

Prevention Strategies Completed by EP/Cath Lab Physicians, Managers, and Technicians Stratified by the Presence or Absence of Low Back Pain (LBP)

Prevention Strategy	LBP (n=15)	No LBP (n=11)
Currently participate in early morning fitness program	6	2
Includes strength training exercises	4	1
Includes stretching exercises	4	2
Overall do you do your fitness program regularly	6	2
Worksite-based fitness program currently offered to dept	4	2
Lead daily by a facilitator	0	0
Worksite-based fitness program offered to dept in the past	0	0
Occurred on company-time	0	0
Each class included exercises targeting the various muscle groups of the body	2	1
Customized around dept's specific needs, preferred communication methods, and resources available to the employees to help create a sense of ownership	1	1
Ergonomic-related topics discussed during team meetings	1	0
Includes discussion on poor posture(s)	0	0
Includes discussion on stress management	0	0
Includes discussion on active coping strategies	0	0
Strategies developed to overcome limited time to stretch	5	4
Strategies developed to overcome lack of regular breaks	7	4
Strategies developed to overcome requirement to keep the body in a sustained forward-flexed posture during surgery	4	2
Regularly complete at least 150 minutes per week of moderate-intensity aerobic physical activity	9	8
Regularly complete stretching exercises	7	4
Regularly complete strength training exercises two or more days/week	7	3
Systematically change number of sets, reps, or weight used in strength training program	5	1
Know how to engage the deep core muscles	9	8
Hospital management believes improvements in physical conditioning will help to prolong career	5	5
Low back pain and other musculoskeletal symptoms periodically evaluated	0	2
Functional Movement Screen or another validated screening tool periodically used to identify faulty movement patterns or muscular imbalances	1	2

The top two prevention strategies reported by both those with low back pain and those with no low back pain were "regularly complete at least 150 minutes per week of moderate-intensity aerobic physical activity" and "know how to engage the deep core

muscles." Furthermore, those with low back pain tended to report they currently participate in an early morning fitness program, regularly complete stretching and strength training exercises, and developed strategies to overcome lack of regular breaks. The only two categories in which those with no low back pain reported more prevention strategies completed include "low back pain and other musculoskeletal symptoms periodically evaluated" and "Functional Movement Screen or another validated screening tool periodically used to identify faulty movement patterns or muscular imbalances."

As previously noted, females tended to report more low back pain while males tended to report less back pain, even though the study population was almost evenly split between the genders (Table 2). Table 4 stratified the data by gender and summarized the totals related to each low back pain prevention strategy completed.

Table 4

Prevention Strategies Completed by EP/Cath Lab Physicians, Managers, and Technicians Stratified by Gender

Prevention Strategy	Male (n=14)	Female (n=12)
Currently participate in early morning fitness program	5	3
Includes strength training exercises	2	3
Includes stretching exercises	3	3
Overall do you do your fitness program regularly	5	3
Worksite-based fitness program currently offered to dept	2	4
Lead daily by a facilitator	0	0
Worksite-based fitness program offered to dept in the past	0	0
Occurred on company-time	0	0
Each class included exercises targeting the various muscle groups of the body	1	2
Customized around dept's specific needs, preferred communication methods, and resources available to the employees to help create a sense of ownership	1	1
Ergonomic-related topics discussed during team meetings	0	1
Includes discussion on poor posture(s)	0	0
Includes discussion on stress management	0	0

Table 4 (continued)

Includes discussion on active coping strategies	0	0
Strategies developed to overcome limited time to stretch	3	6
Strategies developed to overcome lack of regular breaks	4	7
Strategies developed to overcome requirement to keep the body in a sustained forward-flexed posture during surgery	3	3
Regularly complete at least 150 minutes per week of moderate-intensity aerobic physical activity	11	6
Regularly complete stretching exercises	6	5
Regularly complete strength training exercises two or more days/week	7	3
Systematically change number of sets, reps, or weight used in strength training program	4	2
Know how to engage the deep core muscles	10	7
Hospital management believes improvements in physical conditioning will help to prolong career	4	6
Low back pain and other musculoskeletal symptoms periodically evaluated	2	0
Functional Movement Screen or another validated screening tool periodically used to identify faulty movement patterns or muscular imbalances	3	0

In terms of injury prevention, the data showed males tended to focus their attention on the frequency, intensity, time, and type of exercise performed. The top prevention strategies reported by males include “regularly complete at least 150 minutes per week of moderate-intensity aerobic physical activity,” “know how to engage the deep core muscles,” “regularly complete strength training exercises two or more days/week,” and “currently participate in an early morning fitness program.” Alternatively, females tended to address injury prevention by combining regular exercise with management support and strategies to overcome perceived barriers in the workplace. The top prevention strategies reported by females include “know how to engage the deep core muscles,” “strategies developed to overcome lack of regular breaks,” “strategies developed to overcome limited time to stretch,” “regularly complete at least 150 minutes per week of moderate-intensity aerobic physical activity,” and “hospital management believes improvements in physical conditioning will help to prolong career.”

The next step was to use an independent t-test to compare the number of prevention strategies completed by those with reported low back pain versus those with no reported low back pain. When the total number of "Yes" responses to each prevention strategy, per person, were compared, the scores ranged from a high value of 15 best practices completed to a low value of one best practice completed. Those individuals with low back pain completed more prevention strategies (M=5.8, SD=3.6) than those individuals without low back pain (M=4.9, SD=2.5), but the difference was not significant with the independent t-test, $t(24)=.70$, $p=.49$, $d=.28$.

Next, musculoskeletal symptoms were examined to determine if those individuals who completed more low back pain prevention strategies experience less musculoskeletal symptoms than those individuals who completed fewer, if any, prevention strategies. A Pearson correlation revealed no significant relationship between the number of prevention strategies completed and the NMQ number of "Yes" responses, $r(24)=-.013$, $p=.95$, two-tailed. This result may be attributed to some individuals reporting musculoskeletal symptoms within the last year, but not having to miss work because of their pain and/or not experiencing symptoms within the last week. As a method to address this possibility, a Pearson correlation revealed no significant relationship between the number of prevention strategies completed and the prevalence of musculoskeletal symptoms in the nine regions of the body, $r(24)=-.043$, $p=.83$.

Discussion

The first specific aim of the study was to determine the prevalence of low back pain and other musculoskeletal symptoms within the EP/Cath lab community. When asked "have you at any time during the last 12 months had trouble (ache, pain, discomfort, numbness) in" each of the nine regions of the body, low back pain was found

to be the most prevalent musculoskeletal symptom recorded, both in terms of trouble in the past 12 months (57.69%) and trouble in the past seven days (19.23%). Comparing these results to the literature, Bergeron et al. (2006) surveyed 63 Radiologic Technologists and found low back pain to be the most prevalent musculoskeletal symptom recorded. Regarding the frequency of musculoskeletal symptoms, Bergeron et al. (2006) noted 47.62% experienced back pain within the last five years, 42.86% experienced back pain within the last year, and 33.33% experienced back pain either weekly, daily, or constantly. Comparing the two studies, the current study showed a higher overall pervasiveness of low back pain (57.69% to 47.62%), but less low back pain symptoms on a short-term basis (19.23% to 33.33%). Despite these discrepancies, low back pain was found to be the most prevalent musculoskeletal symptom recorded in both studies.

The second specific aim of the study was to determine the current use of prevention strategies within the EP/Cath lab community. The top two prevention strategies reported by both those with low back pain and those with no low back pain were “regularly complete at least 150 minutes per week of moderate-intensity aerobic physical activity” and “know how to engage the deep core muscles.” Furthermore, those with low back pain tended to report they currently participate in an early morning fitness program, regularly complete stretching and strength training exercises, and developed strategies to overcome lack of regular breaks. It is unknown if the completion of prevention strategies occurred prior to or following the onset of low back pain. This distinction is worth noting because McGill (2016, p. 292) suggested poor technique while stretching can lead to extra loading on the lumbar spine and thus, more low back pain. In terms of injury prevention, the services of a physical therapist, certified personal

trainer, or health educator who is qualified to design a comprehensive exercise program are warranted to instruct EP/Cath lab professionals on how to maintain a neutral spine while completing stretching exercises (McGill, 2016, p. 292) and improve core stability to ultimately enhance hip mobility (McGill, 2016, p 94). Interestingly, no responses were recorded when asked if their worksite-based fitness program was led daily by a facilitator or occurred on company time, and only one response was recorded when asked if ergonomic-related topics were discussed during team meetings. These findings suggest it is the cultural norm of the EP/Cath lab community to believe it is the personal responsibility of the employee rather than shared responsibility of the employee and hospital management to address the widespread low back pain present in the workforce, personified by only 38.46% of physicians, managers, and technicians reporting "hospital management believes improvements in physical conditioning will help to prolong career." Comparing these results to the literature, Bergeron et al. (2006) noted 23.81% completed "exercise/stretching" as their treatment option for low back pain, but all 63 individuals included in the study were asked this question, regardless of the presence or absence of low back pain. Alternatively, my study showed 60.00% of those with reported low back pain regularly complete at least 150 minutes per week of moderate-intensity aerobic physical activity. This figure is slightly higher than the percentage of average adults (52.6%) who complete the recommended amount of aerobic physical activity each week (Office of Disease Prevention and Health Promotion, 2018b).

The third specific aim of the study was to examine the relationship between the completion of prevention strategies and the prevalence of low back pain and musculoskeletal symptoms. Although no significant difference was found in the number of prevention strategies completed by those with reported low back pain versus those

with no reported low back pain, data trends showed an increase in the prevalence of low back pain as the number of years working in an EP/Cath lab setting increased. This finding was expected based on previous research. Goldstein, Balter, Cowley, Hodgson, and Klein (2004) surveyed 423 interventional cardiologists and noted a similar upward trajectory of reported spine problems as the number of years of invasive practice increased. Regarding another finding of the study, the number of prevention strategies completed was not found to be related to the amount of musculoskeletal symptoms experienced. When the completion of prevention strategies was stratified by gender, the data showed males tended to take a more fitness-focused approach to the completion of prevention strategies while females tended to prefer the combination of fitness with strategic planning and management support. As fewer than 20% of cardiologists are female (Casey, 2016), the results of this study suggest the achievement of a balance between the preferences of the majority and minority may be difficult to obtain.

To conclude, this study sought to identify the musculoskeletal symptoms experienced and preventative strategies completed by a sample of EP/Cath lab professionals. Although the sample was limited, the data and findings are of interest due to the lack of data on the role of exercise and physical activity routines, health education, and continued management support as low back pain prevention strategies in the EP/Cath lab community. The completion of moderate-intensity aerobic physical activity and the engaging of the deep core muscles were the top two prevention strategies reported by those included in this study. In addition, this study produced the creation of a novel research survey instrument which has the potential to be administered to other EP/Cath lab professionals to eventually grow the data set (Hackshaw, 2008). The results of this study can be translated into practice and result in the encouragement of

EP/Cath lab physicians, management, and staff to complete these prevention strategies inside and outside of the hospital until more data become available from future research.

Conclusion

The results of this study showed those individuals who completed a variety of low back pain prevention strategies did not experience less musculoskeletal symptoms than those individuals who completed fewer, if any, prevention strategies. Two factors may contribute to why this relationship was not found. First, the sample size of the study may not have been large enough to detect a significant relationship between these two variables. Second, a relatively low number of best practices were reported by those included in the study. This finding showed several low cost/low risk preventative strategies for reducing musculoskeletal symptoms in the workforce are not currently being completed. It is beyond the scope of this study to imply the omitted completion of these prevention strategies was the cause of the musculoskeletal symptoms identified in the study population. Rather, the surveying of EP/Cath lab professionals who regularly complete a relatively high number of prevention strategies is suggested for future research, assuming this subset of the EP/Cath lab community should exist. In addition, the completion of ethnographic research on an EP/Cath lab department which reported a low prevalence of musculoskeletal symptoms is suggested for future research to uncover and analyze how it was able to achieve a culture of wellness. Once completed, this research has the potential to be repurposed and applied as a pilot program in other EP/Cath labs or hospital departments for the betterment of the hospital employee population. Since no data concerning this potentially serious issue could be found in the literature, it makes sense to use the results from this small study for now to help EP/Cath lab professionals maintain low back and other musculoskeletal health.

CHAPTER II

DISSEMINATION

The first step in disseminating this research is to present to a community of influential health professionals who may be receptive to the findings of this dissertation. I decided to target the Duke University Health System due to the many connections I have within this healthcare organization. Within Duke, several opportunities for the dissemination of my research exist, including the Duke AHEAD Health Professions Education Day, Duke Health Patient Safety and Quality Conference, and Duke Employee Occupational Health & Wellness Seminar. I targeted these three events because I have previously attended all three as either an exhibitor or participant, and I know the best individuals to contact to be included in future events. In the end I requested permission to present at the Duke Employee Occupational Health & Wellness Seminar for three key reasons. First, I would be able to create an adaptable and reusable PowerPoint presentation as the medium of my dissemination rather than a static research poster. Second, I would have the full attention of my target audience during my presentation rather than the fleeting attention of a multitude of healthcare providers as they walk past my research poster. Third, this monthly seminar is regularly attended by medical doctors, registered nurses, and other Duke stakeholders who have the shared goal of reducing the number of musculoskeletal disorders in the employee population.

The main purpose of the presentation is to bring increased awareness to the issue of low back pain in the EP/Cath lab community and the perceived efforts being

taken by EP/Cath lab physicians, managers, and technicians to address this issue. To achieve this purpose, three goals for the presentation has been devised:

1. Review the purpose, methodology, results, and discussion sections of this study.
2. Review the conclusion section and describe my future plans for this research.
3. Provide an example of what a pilot worksite-based fitness program may look like.

The challenge of this presentation will be finding a balance between the explanation of my dissertation and the description of what the literature suggests a pilot worksite-based fitness program may look like. Ultimately, I seek to identify a Duke stakeholder whom I can partner with to pursue my research agenda.

Presentation Details

The following presentation is organized and outlined by PowerPoint slides and written as it would be presented to accompany the PowerPoint slides (Appendix D).

Introduction (Slide #1).

Musculoskeletal disorders, such as low back pain, are a common, costly problem in the hospital workforce (Katz, 2006). This is due to the regular lifting, positioning, and transporting of patients, fast pace work environment, and a general collective temperament of putting their patient's health before their own (OSHA, 2013). Those employees who work in a hospital's electrophysiology or catheterization lab (EP/Cath lab) appear to be especially susceptible to injury. EP/Cath lab professionals regularly maintain forward-flexed postures for extended periods of time while working in the operating room (Johnson, 2012). Traditionally exercise and physical activity routines, health education, and continued management support have been promoted as low cost/low risk interventions to address low back pain, but the extent to which hospital policy and culture enable these prevention strategies to be completed is unknown.

Thus, this study explored the perceived effectiveness of these investments in wellness from the perspective of the EP/Cath lab professional.

Learning objectives (Slide #2).

Here are the three learning objectives of today's presentation:

1. Review the purpose, methodology, results, and discussion sections of this study.
2. Review the conclusion section and describe my future plans for this research.
3. Provide an example of what a pilot worksite-based fitness program may look like.

Purpose and specific aims (Slide #3).

The purpose of this study was to examine the role of exercise and physical activity routines, health education, and continued management support as low back pain prevention strategies in the EP/Cath lab community. To realize this purpose, three specific aims were devised:

1. Determine the prevalence of low back pain and other musculoskeletal symptoms within the EP/Cath lab community.
2. Determine the current use of prevention strategies within the EP/Cath lab community.
3. Examine the relationship between the completion of prevention strategies and the prevalence of low back pain and musculoskeletal symptoms.

Methodology – Subject recruitment and data collection (Slide #4).

Those individuals who work in either an EP or Cath lab setting were eligible to participate in the study. Two populations of EP/Cath lab physicians, managers and technicians were included in the study. First, the UNC School of Medicine was contacted, and permission was granted to use their internal email distribution list of EP/Cath lab managers and technicians to distribute the survey. Second, the North

Carolina chapter of the American College of Cardiology (ACC) was contacted, and permission was granted to attend their 2018 annual chapter meeting to administer the survey via iPad to conference attendants.

Methodology – Data instrumentation (Slide #5).

Continuing our discussion on the methodology of the study, the Qualtrics survey used was an instrument designed specifically for this research. It included three general sections: NMQ, demographics/applicable work practice details, and low back pain prevention strategies. The first section featuring the NMQ was used to calculate the prevalence of musculoskeletal symptoms in nine different regions of the body. The second section of the survey assessed demographics and applicable work practice details. Finally, the third section on low back pain prevention strategies assessed exercise and physical activity routines, health education, and continued management support.

Results (n=26) (Slide #6).

Next, we will turn our discussion to the results of the study. A total of 26 completed surveys were included in the final data set. Low back pain was the most prevalent musculoskeletal symptom recorded, both in terms of trouble in the past 12 months (57.69%) and trouble in the past seven days (19.23%). This finding is aligned with the literature (Bergeron, Wright, & Killion, 2006). Furthermore, data trends showed an increase in the prevalence of low back pain as the number of years working in an EP/Cath lab setting increased. Again, this finding is aligned with the literature (Goldstein, Balter, Cowley, Hodgson, & Klein, 2004). Results of an independent t-test indicated that those individuals with low back pain completed more prevention strategies (M=5.8, SD=3.6) than those individuals without low back pain (M=4.9, SD=2.5), but the

mean difference was not significant, t(24)=.70, p=.49, d=.28. Finally, a Pearson correlation revealed no significant relationship between the number of prevention strategies completed and the Nordic Musculoskeletal Questionnaire number of “Yes” responses, r(24)=-.013, p=.95.

Discussion (Slide #7).

For the discussion section we will focus our attention on the low back pain prevention strategies reported in the study. The top two prevention strategies reported by both those with low back pain and those with no low back pain were “regularly complete at least 150 minutes per week of moderate-intensity aerobic physical activity” and “know how to engage the deep core muscles.” Furthermore, those with low back pain tended to report they currently participate in an early morning fitness program, regularly complete stretching and strength training exercises, and developed strategies to overcome lack of regular breaks. Interestingly, no responses were recorded when asked if their worksite-based fitness program was led daily by a facilitator or occurred on company time, and only one response was recorded when asked if ergonomic-related topics were discussed during team meetings. These findings suggest it is the cultural norm of the EP/Cath lab community to believe it is the personal responsibility of the employee rather than shared responsibility of the employee and hospital management to address the widespread low back pain present in the workforce.

Conclusion (Slide #8).

This study sought to identify the musculoskeletal symptoms experienced and preventative strategies completed by a sample of EP/Cath lab professionals. The results of this study showed those individuals who completed more low back pain prevention strategies did not experience less musculoskeletal symptoms than those

individuals who completed fewer, if any, prevention strategies. Two factors may contribute to why this relationship was not found. First, the sample size of the study may not have been large enough to detect a significant relationship between these two variables. Second, a relatively low number of best practices were reported by those included in the study. This finding shows several low cost/low risk preventative strategies for reducing musculoskeletal symptoms in the workforce are not currently being completed by those EP/Cath lab physicians, managers, and technicians who participated in the study. It is beyond the scope of this study to imply the omitted completion of these low back pain prevention strategies was the cause of the musculoskeletal symptoms identified in the study population. Rather, the identification and surveying of EP/Cath lab professionals who regularly complete a relatively high number of prevention strategies is suggested for future research, assuming this subset of the EP/Cath lab community should exist. In addition, the completion of ethnographic research on EP/Cath lab departments which report a low prevalence of musculoskeletal symptoms is suggested for further research to uncover and analyze how they were able to achieve cultures of wellness. Once completed, this research has the potential to be repurposed and applied as a pilot program in other EP/Cath labs or hospital departments for the betterment of the hospital employee population.

Example of a pilot worksite-based fitness program (Slide #9).

I believe my Duke University peers and LIVE FOR LIFE teammates have the potential to apply aspects of my dissertation for the betterment of the Duke employee population. Although the focus of my dissertation was on the population of EP/Cath lab workers, my research may be transferrable to other medical departments which regularly use diagnostic medical imaging equipment and require their staff to wear radiation

protection garments (Lamar, 2004; S. Powell, personal communication, February 14, 2017). As such, this dissertation, combined with other material, has the potential to be applied as a functional blueprint in the design of worksite-based fitness programs in several other Duke departments. Knowing this, let us turn our attention to what the literature suggests the design of a pilot worksite-based fitness program may look like.

Step 1: Secure EP/Cath lab senior management support (Slide #10).

Continued management support throughout the entirety of the program is paramount in realizing significant, lasting results (Smith, 2013). One such motivation for continued support may be the belief that improvements in the physical conditioning of the physicians and staff will help to prolong their careers. Understanding management's motivation is important because the offering of a daily facilitator-led class on company-time consequentially produces significant staffing costs for the department in the process (Gartley & Prosser, 2011; Starr, 2007). During the needs assessment phase of the program, supervisor interviews and management concerns should be considered in the design of the program to help create a sense of ownership (Cornelius, Turin, Wiehagen, & Gallagher, n.d.). To accomplish this goal, the various program designer/management sessions should be used to further customize the program around the department's specific needs, preferred communication methods, and resources available to their employees. Strategies can be developed at this time to preemptively address the EP/Cath lab-specific barriers of limited time to stretch (Christenssen, 2001), lack of regular breaks (J. Harrell, personal communication, January 25, 2017), and requirement to keep the body in a sustained forward-flexed posture during surgery (Johnson, 2012).

Step 2: Pre-assessment (Slide #11).

The next step in the process is the pre-assessment. Because back pain is a recurrent problem, the strongest and most consistent predictor of future back pain is the individual's history of back pain (Waddell, 2004). It must be noted I am not a clinician and to stay within my specific scope of practice, I propose the pre-assessment should comprise of the Qualtrics survey which I used in my dissertation and the completion of a Functional Movement Screening.

Goals/Objectives (Slide #12).

The temptation exists to define the success the program as the elimination of back pain in __% of the staff, while achieving a positive ROI in the process. However, this definition of success is ill-advised because back pain is a recurrent problem. My solution is the creation of both qualitative and quantitative objectives which fall under the goal categories of Participation, Satisfaction, Health Improvement, and Financial. I developed these goals and objectives based on the knowledge that the longer the time since the last attack of back pain, the lower the chance of reoccurrence (Waddell, 2004).

Step 3: Implement worksite-based fitness program (Slide #13).

Next, we will turn our attention to the implementation of the worksite-based fitness program. Ideally the facilitator of the daily class is a physical therapist, certified personal trainer, or health educator who is qualified to design a comprehensive exercise program which includes these specific components. On the other hand, if this is not feasible due to budget and/or time restraints, the facilitator could lead the class on a periodic basis and several rotating volunteers within the department could lead the class on the days he/she cannot make it. The two key points to remember are the classes are lead daily by a facilitator and occur on company-time. The daily class should be

completed at either the start or end of a shift or at some other time that has minimal disruption to the work schedule.

Step 4: Promote independent exercise component (Slide #14).

Some might be more comfortable exercising on their own rather than at work. Therefore, the offering of virtual fitness programming to all participants is suggested. For example, Wellbeats offers a range of fitness classes for every age, stage, and ability which can be accessed at the convenience of the participant (Wellbeats, 2018). To make sure planned, fixed increases to the workout program are made, the distribution of an exercise tracker is suggested. The goal is the completion of the independent exercise component a minimum of five times per week (Jaromi, Nemeth, Kranicz, Laczko, & Betlehem, 2012) for a period of 20-60 minutes per session (Freimann, Merisalu, & Paasuke, 2015). When combined with the weekly facilitator-led class, these exercise recommendations are aligned with the Physical Activity Guidelines for adults (Office of Disease Prevention and Health Promotion, 2018).

Step 5: Discuss ergonomic-related topics during team meetings (Slide #15).

Next, short educational talks should be provided to the entire EP/Cath Lab team on work time during one of their weekly mandatory meetings (Smith, 2013). This strategy permits those EP/Cath lab employees who are uninterested in participating the daily classes or independent exercise component to at least receive pertinent ergonomic educational information.

Step 6: Post-assessment (Slide #16).

Bringing our attention back to the worksite-based fitness program, I propose the post-assessment should comprise of the completion of the Qualtrics survey at the one-year mark and the completion of a FMS at both the 6-month mark and one-year mark.

The reason why this pilot program is one year in duration is due to the NMQ specifically asking “have you at any time in the last 12 months had trouble in…” and “have you at any time during the last 12 months been prevented from doing your normal work (at home or away from home) because of the trouble?”

Continuity after 1 year (Slide #17).

Once this one-year mark has been reached, senior management will have to decide whether to continue this pilot program in its current form, edit some of its components, or cease the program altogether. In the ideal scenario, a member of senior management would become the “owner” of the program, several EP/Cath lab staff would volunteer to be the daily class leader, and these responsibilities would be reflected in the annual staff review. If this best-case scenario was to occur, departmental budget dollars would need reallocated to fund the costs associated with new exercise equipment and the renewal of the staff’s annual Wellbeats memberships. Finally, the NMQ and FMS could be completed on a reoccurring basis to provide further proof that the program is functioning as planned. With senior management support, staff engagement, long-term funding, and promising metrics, evidence would be found supporting the expansion of the program to other departments within the hospital system.

Conclusion (Slide #18).

In conclusion, previous studies have shown musculoskeletal disorders are a common occupational hazard experienced by those who work in an EP/Cath lab setting (Klein et al, 2009). However, the extent to which prevention strategies were completed by those surveyed in these studies was not explored. I targeted this gap in the literature and my research suggests several low cost/low risk preventative strategies for reducing musculoskeletal symptoms in the workforce were not being completed by those who

participated in my study. As for what comes next, I seek to use my dissertation endeavors and future research agenda to advocate stakeholders for changes in hospital policy to permit the offering of worksite-based fitness programs on paid company time. Thank you.

CHAPTER III

ACTION PLAN

I am currently employed in the field of corporate wellness as the Health Promotion Manager of Duke University's LIVE FOR LIFE employee wellness program. In the most general sense I am expected to work with Duke stakeholders, local community organizations, and my teammates to "promote a work culture and environment that supports healthy and safe behaviors/lifestyles" (Duke Human Resources, 2018). As the Health Promotion Manager, my primary work responsibilities include the assessment, planning, implementation, and evaluation of health promotion programs which complement our department's annual business plan. Although within my department fitness and health education are two separate divisions, my unique educational background in both Kinesiology and Health Promotion permits additional intra-departmental collaboration. One such intra-departmental collaboration which I am periodically requested to lead involves the creation of worksite-based fitness programs. Although I have designed several worksite-based fitness programs over the past 10 years, unfortunately most fail to continue past the point in which I remove myself from the active management of the program. Therefore, I decided to use the most recent request I received for the creation of a worksite-based fitness program as the motivation behind my dissertation endeavors. Through my research I sought to identify the best practices which go into a worksite-based fitness program, and more importantly, suggest practical ways to use this information when designing health promotion programs to address low back pain and other musculoskeletal disorders.

My action plan uses the ecological model as the framework for the dissemination of my research findings (American College Health Association, 2016). First, this dissertation experience has strongly influenced my personal physical fitness routine. As a seasoned personal trainer, I am expected to exercise on a consistent basis. Since beginning my dissertation I increased my strength training to three days per week and found planned, fixed increases in exercise intensity and duration have helped me realize progressive decreases in back pain (Waddell, 2004, p. 378).

Second, my Duke University peers and LIVE FOR LIFE teammates have the potential to apply aspects of my dissertation for the betterment of the Duke employee population. Although the focus of my dissertation was on the population of EP/Cath lab workers, my research may be transferrable to other medical departments which regularly use diagnostic medical imaging equipment and require their staff to wear radiation protection garments (Lamar, 2004; S. Powell, personal communication, February 14, 2017). As such, this dissertation, combined with other material, has the potential to be applied as a functional blueprint in the design of worksite-based fitness programs in several other Duke departments. My long-term goal is to implement a pilot worksite-based fitness program based on the low back pain prevention strategies referenced in the Qualtrics survey designed specifically for this dissertation.

Third, silos appear within the corporate wellness environment on the institutional level in the following forms: onsite fitness centers, onsite health centers, employee assistance programs, occupational health departments, safety departments, facility departments, food service departments, and human resource departments. Health and behaviors are complementary, mixed, and deeply interrelated and the silo mentality does not fit nicely with this reality. My goal is to use my dissertation endeavors to advocate

for more interdepartmental collaboration among corporate wellness entities for the potential benefit of EP/Cath lab staff members, as well as for the potential benefit of the staff in other hospital departments. One such way I plan to pursue this task is through the presentation of my research findings at an upcoming meeting of the Employee Occupational Health & Wellness Seminar. This talk is regularly attended by medical doctors, registered nurses, and other Duke stakeholders who have the shared goal of reducing the number of musculoskeletal disorders in the employee population.

Fourth, I intend to use my membership into the ACC as my primary source of contact with the EP/Cath lab community. The next step of my research agenda is to identify and survey EP/Cath lab professionals who regularly complete a relatively high number of prevention strategies, assuming this subset of the EP/Cath lab community should exist, to potentially determine if number of prevention strategies completed is inversely correlated to the amount of low back pain experienced. To complete this task, I plan to target those individuals who authored articles in ACC publications on employee wellness-related topics. In addition, I plan to seek out ACC members who are actively serving in the military, and thus, are required to maintain specific physical fitness standards while in service. Furthermore, I intend to join the ACC Cardiovascular Team Member Section to network with other members who share similar research interests. Upon completion of this specific research, I hope to disseminate the findings via presentation at the 2019 NC & SC Chapters ACC Annual Joint Meeting or via poster at the ACC's Annual Scientific Session & Expo in 2020.

Finally, businesses regularly hire personal trainers and health educators to implement health promotion programs as a way to address the significant financial impact musculoskeletal disorders have on their organizations (Goetzel et al., 2014), but

it must be noted these professionals are not clinicians and must take care to stay within their specific scope of practice. Research suggests the combination of ergonomic education, strengthening exercises, and stretching exercises can produce significant reductions in low back pain in a general inpatient nurse population (Jaromi et al., 2012), but the implementation of interventions will take the political will of hospital management to finance these programs and provide the necessary resources for their initial and continued success. Therefore, I seek to use my dissertation endeavors and future research agenda to bring increased awareness to the issue of low back pain in the EP/Cath lab community and advocate stakeholders for changes in hospital policy to permit the offering of worksite-based fitness programs on paid company time.

REFERENCES

American College Health Association. (2016). *Ecological model*. Retrieved from https://www.acha.org/HealthyCampus/Implement/Ecological_Model/HealthyCampus/Ecological_Model.aspx?hkey=f5defc87-662e-4373-8402-baf78d569c78

Bergeron, J., Wright, D., & Killion, J. (2006). Low back pain among radiologic technologists. *Cath Lab Digest, 14*(6). Retrieved from http://www.cathlabdigest.com/articles/Low-Back-Pain-Among-Radiologic-Technologists

Bureau of Labor Statistics. (2018). *Occupational Employment Statistics*. Retrieved from https://www.bls.gov/oes/current/oes292031.htm#st

Casey, T. (2016). *ACC survey finds fewer than 20% of cardiologists are women*. Retrieved from https://www.cardiovascularbusiness.com/topics/practice-management/acc-survey-finds-fewer-20-cardiologists-are-women

Christenssen, W. (2001). Stretch exercises: Reducing the musculoskeletal pain and discomfort in the arms and upper body of echocardiographers. *Journal of Diagnostic Medical Sonography, 17*(3), 123-140.

Christman, M., Fan, W., Fiszer, J., & Hunt, M. (2013). *Radiation protective apron ergo project*. Retrieved from http://nora.mech.utah.edu/files/2013/11/NORA-Poster_Lead-Apron-Ergo-Project.pdf

Comelli, I., Vignali, L., Rolli, A., Lippi, G., & Cervellin, G. (2012). Achievement of a median door-to-balloon time of less than 90 minutes by implementation of organizational changes in the ‘emergency department to cath lab’ pathway: A 5-

year analysis. *Journal of Evaluation in Clinical Practice, 18*(4), 788-792. doi:10.1111/j.1365-2753.2011.01673.x

Crawford, H., Neil, J., & Thomas, S. (2014). Construction + ergonomics = a non-traditional focus for a top 20 U.S. contractor. In *ASSE Professional Development Conference and Exposition*. American Society of Safety Engineers. Retrieved from http://www.asse.org/assets/1/7/726_crawford_neil_thomas.pdf

Crawford, J. (2007). The Nordic musculoskeletal questionnaire. *Occupational Medicine, 57*(4), 300-301. doi:10.1093/occmed/kqm036

Duke Human Resources. (2018). *Employee Occupational Health & Wellness (EOHW)*. Retrieved from https://hr.duke.edu/wellness/eohw

Freimann, T., Merisalu, E., & Paasuke, M. (2015). Effects of a home-exercise therapy programme on cervical and lumbar range of motion among nurses with neck and lower back pain: A quasi-experimental study. *BMC Sports Science, Medicine & Rehabilitation, 7*(1). doi:10.1186/s13102-015-0025-6

Gartley, R., & Prosser, J. (2011). Stretching to prevent musculoskeletal injuries: An approach to workplace wellness. *AAOHN Journal, 59*(6), 247-252. https://doi.org/10.1177/216507991105900603

Goetzel, R., Henke, R., Tabrizi, M., Pelletier, K., Loeppke, R., Ballard, D.,...Serxner, S. (2014). Do workplace health promotion (wellness) programs work? *Journal of Occupational and Environmental Medicine, 56*(9), 927-934. doi:10.1097/JOM.0000000000000276

Goetzel, R., Roemer, E., Liss-Levinson, R., & Samoly, D. (2008). *Workplace health promotion: Policy recommendations that encourage employers to support health improvement programs for their workers*. Retrieved from

http://www.prevent.org/data/files/initiatives/workplacehealtpromotion-policyrecommendations.pdf

Goldstein, J., Balter, S., Cowley, M., Hodgson, J., & Klein, L. (2004). Occupational hazards of interventional cardiologists: Prevalence of orthopedic health problems in contemporary practice. *Catheterization and Cardiovascular Interventions, 63*(4), 407–411. doi:10.1002/ccd.20201

Hackshaw, A. (2008). Small studies: Strengths and limitations. *European Respiratory Journal, 32*(5), 1141-1143.

Jaromi, M., Nemeth, A., Kranicz, J., Laczko, T., & Betlehem, J. (2012). Treatment and ergonomics training of work-related lower back pain and body posture problems for nurses. *Journal of Clinical Nursing, 21*(11/12), 1776-1784. doi:10.1111/j.1365-2702.2012.04089.x

Johnson, D. (2012). *Efficacy of a novel thoracopelvic orthosis in reducing lumbar spine loading and muscle fatigue in flexion: A study with weighted garments* (Doctoral dissertation). Retrieved from https://deepblue.lib.umich.edu/bitstream/handle/2027.42/91450/danijohn_1.pdf?sequence=1&isAllowed=y

Katz, J. (2006). Lumbar disc disorders and low-back pain: Socioeconomic factors and consequences. *Journal of Bone & Joint Surgery, 88*(2)(Suppl.), 21-24. https://doi.org/10.2106/JBJS.E.01273

Klein, L., Miller, D., Balter, S., Laskey, W., Haines, D., Norbash, A.,…Goldstein, J. (2009). Occupational health hazards in the interventional laboratory: Time for a safer environment. *Radiology, 250*(2). http://dx.doi.org/10.1148/radiol.2502082558

Kuorinka, I., Jonsson, B., Kilbom, A., Vinterberg, H., Biering-Sørensen, F., Andersson, G., & Jorgensen, K. (1987). Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. *Applied Ergonomics, 18*(3), 233-237. http://dx.doi.org/10.1016/0003-6870(87)90010-X

Lamar, S. (2004). *Investigation of factors associated with prevalence and severity of musculoskeletal symptoms among the workers in a clinical specialties of radiologic technology: An ergonomic and epidemiological approach* (Masters thesis). Retrieved from https://repository.lib.ncsu.edu/bitstream/handle/1840.16/143/etd.pdf?sequence=1

Lenderink, A. & Zoer, I. (2012). *Review on the validity and reliability of self-reported work-related illness*. Retrieved from http://www.hse.gov.uk/research/rrpdf/rr903.pdf

McGill, S. (2016). *Low back disorders: Evidence-based prevention and rehabilitation* (3rd ed.). Champaign, IL: Human Kinetics.

Occupational Safety and Health Administration. (2013). *Caring for our caregivers: Facts about hospital worker safety*. Retrieved from https://www.osha.gov/dsg/hospitals/documents/1.2_Factbook_508.pdf

Occupational Safety and Health Administration. (2014). *Prevention of work-related musculoskeletal disorders*. Retrieved from https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=UNIFIED_AGENDA&p_id=4481

Office of Disease Prevention and Health Promotion. (2018a). *Physical activity guidelines for Americans* (2nd ed.). Retrieved from https://health.gov/paguidelines/second-edition/pdf/Physical_Activity_Guidelines_2nd_edition.pdf

Office of Disease Prevention and Health Promotion. (2018b). *Search the data*. Retrieved from https://www.healthypeople.gov/2020/data-search/Search-the-Data#topic-area=3504;

O'Riordan, M. (2005). *Bad backs and aching necks: Occupational hazards of the cath lab*. Retrieved from http://www.medscape.com/viewarticle/787327

Qaseem, A., Wilt, T., McLean, R., Forciea, M., & Clinical Guidelines Committee of the American College of Physicians. (2017). Noninvasive treatments for acute, subacute, and chronic low back pain: A clinical practice guideline from the American College of Physicians. *Annals of Internal Medicine, 166*, 514-530. https://doi.org/10.7326/M16-2367

Smith, K. (2013). Evaluation of a stretching program to increase worker flexibility. *Workplace Health & Safety, 61*(8), 329-332. http://dx.doi.org/10.3928/21650799-20130726-30

Spine Research Institute. (2014, September 5). Indirect costs of back pain and MSDs [Web log comment]. Retrieved from https://spine.osu.edu/blog/2014/09/indirect-costs-back-pain-and-msds

University of Massachusetts Lowell. (2011). *Ergonomic training for nursing home workers*. Retrieved from https://www.osha.gov/dte/grant_materials/fy11/sh-22314-11/workers_manual.pdf

Waddell, G. (2004). *The back pain revolution* (2nd ed.). Edinburgh: Churchill Livingstone.

Wheeler, R. (2015). Limiting lower back injuries with proper technique and strengthening. *Strength and Conditioning Journal, 37*(1), 18-23.

APPENDIX A

ACC LETTER OF SUPPORT

North Carolina
CHAPTER

5-15-18

Recently I was contacted by Nicholas Beresic in regards to the attending of the 2018 NC/SC Chapter Annual Conference for the collection of research data. Nicholas is an active member of the American College of Cardiology as a Cardiovascular Team Member. Additionally, he is currently enrolled as a doctoral student in the University of North Carolina at Greensboro's EdD in Kinesiology program and completing his dissertation on hospital workers and low back pain. The goal of Nicholas' research is to examine the significance of exercise and physical activity routines, health education, and continued management support as low back pain prevention strategies in the EP/Cath lab community.

Nicholas informed me he has created a brief 5-minute Qualtrics survey which he would like to offer live to conference meeting attendants. His questions are broadly grouped into three sections: the Nordic Musculoskeletal Questionnaire, demographics/applicable work practices, and low back pain prevention strategies. Nicholas assured me all collected data would be properly de-identified, as names and any other form of PHI would not be collected in his survey. His hope is a majority of meeting attendants would complete the survey and he has set the goal of collecting between 100-150 completed surveys before the end of the three-day event.

I am pleased to support the research project proposed by Nicholas entitled, Examining Low Back Pain Prevention Strategies in the Electrophysiology and Catheterization Lab. I agree the back health of the hospital workforce is a very timely and relevant topic to the membership base of the ACC. Furthermore, the ACC will support his research efforts and provide him with a physical space at the 2018 NC/SC Chapter Annual Conference to collect his research data. Nicholas is required to submit a Letter of Support to the University of North Carolina at Greensboro's IRB in order to complete his research. Please consider this correspondence as my endorsement of this Letter of Support.

Sincerely,

Beth Penny

Chapter Executive Director

NC Chapter ACC

APPENDIX B

CONSENT FORM

Project Title: Examining low back pain prevention strategies in the electrophysiology and catheterization lab

Principal Investigator: Nicholas Beresic

Faculty Advisor: Pamela Kocher Brown

What is this all about?
I am asking you to participate in this research study to examine the significance of exercise and physical activity routines, health education, and continued management support as low back pain prevention strategies in the EP/Cath lab community. This research project will only take about 5 minutes and will involve you completing a survey in either electronic or paper-based format. Your participation in this research project is voluntary.

How will this negatively affect me?
Other than the time you spend on this project there are no know or foreseeable risks involved with this study.

What do I get out of this research project?
There is no direct benefit in participating in the study.

Will I get paid for participating?
There is no compensation for being in the study.

What about my confidentiality?
We will do everything possible to make sure that your information is kept confidential. All information obtained in this study is strictly confidential unless disclosure is required by law. All responses will be collected anonymously, de-identified for analysis purposes, and stored in the UNCG Box account of the PI, accessible to only the PI and Faculty Advisor. If completing the survey online, please note that absolute confidentiality of data provided through the Internet cannot be guaranteed due to the limited protections of Internet access. Please be sure to close your browser when finished so no one will be able to see what you have been doing.

What if I do not want to be in this research study?
You do not have to be part of this project. This project is voluntary and it is up to you to decide to participate in this research project. If you agree to participate at any time in this project you may stop participating without penalty.

What if I have questions?
You can ask the Nicholas Beresic (njberesi@uncg.edu) or Pamela Kocher Brown (plkocher@uncg.edu) anything about the study. If you have concerns about how you have been treated in this study call the Office of Research Integrity Director at 1-855-251-2351.

By circling "I agree" below, you indicate you have this consent form and agree to be in this study, with the understanding that you may withdraw at any time.

I agree I do NOT agree

APPENDIX C

EMAIL SCRIPT

Dear UNC Healthcare Professional:

My name is Nick Beresic and I am currently enrolled as a doctoral student in the University of North Carolina at Greensboro's EdD in Kinesiology program. You are invited to complete a short survey (approximately five minutes) to examine the significance of exercise and physical activity routines, health education, and continued management support as low back pain prevention strategies in the EP/Cath lab community. Your responses will be anonymous and no identifying information (e.g., name, email address) will be collected by the researcher.

Should you decide not to participate in this study, simply withdraw at any time by closing out of the survey. No data will be collected; however, any submitted data cannot be withdrawn because it is unidentifiable. The decision to withdraw or not participate in the study will not result in any negative consequences. Your consideration and time are greatly appreciated.

To participate in the study and complete the survey, please follow this link to the Survey (You acknowledge that you have not submitted a survey previously and will submit only one survey):

https://uncg.qualtrics.com/jfe/form/SV_6Rs6AF1wdbPKyHj

If you have any questions concerning the study and/or the survey, please contact me via email at njberesi@uncg.edu. Thank you for your consideration and support in the research effort.

Sincerely,

Nicholas Beresic, CHES®, CPT

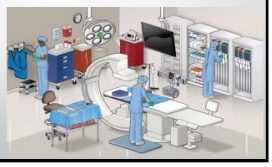
APPENDIX D

POWERPOINT PRESENTATION

Examining Low Back Pain Prevention Strategies in the Electrophysiology and Catheterization Lab

Nicholas Beresic

University of North Carolina at Greensboro



Learning Objectives

- Review the purpose, methodology, results, and discussion sections of this study
- Review the conclusion section and describe my future plans for this research
- Provide an example of what a pilot worksite-based fitness program may look like

Purpose and Specific Aims

Examine the role of exercise and physical activity routines, health education, and continued management support as low back pain prevention strategies in the EP/Cath lab community

- *Specific Aim #1:* Determine the prevalence of low back pain and other musculoskeletal symptoms within the EP/Cath lab community.
- *Specific Aim #2:* Determine the current use of prevention strategies within the EP/Cath lab community.
- *Specific Aim #3:* Examine the relationship between the completion of prevention strategies and the prevalence of low back pain and musculoskeletal symptoms.

Methodology – Subject Recruitment and Data Collection

Qualtrics survey administered to two populations:

UNC SCHOOL OF MEDICINE

Internal email distribution list of EP/Cath lab managers and technicians

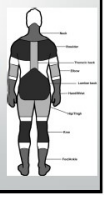
North Carolina CHAPTER

2018 NC & SC Chapters ACC Annual Joint Meeting (Sept 28-30 in Charleston, SC)

Methodology – Data Instrumentation

Three General Sections:

1. Nordic Musculoskeletal Questionnaire (yes vs. no)
   - Have you at any time in the **last 12 months** had trouble in…
   - Last 12 months **been prevented from doing your normal work?**
   - Have you had trouble at any time in the **last 7 days?**
2. Demographics/applicable work practice details
3. Low back pain prevention strategies (yes vs. no)
   - Assessed exercise and physical activity routines, health education, and continued management support



Results (n=26)

1. Musculoskeletal symptoms = LBP most prevalent (57.69% in last year)
2. Demographic/applicable work practices = LBP ↑as # of working years ↑
3. Low back pain prevention strategies = Range of 1-15 completed (25 max)
   - LBP (M=5.8, SD=3.6)
   - No LBP (M=4.9, SD=2.5)
4. Relationship between **NMQ LBP yes/no** and **prevention strategy "Yeses"**
   - Independent t-test = Mean difference was not significant, $t(24)=.70$, $p=.49$, $d=.28$
5. Relationship between **NMQ "Yeses"** and **prevention strategy "Yeses"**
   - Pearson correlation = No significant relationship, $r(24)=-.013$, $p=.95$

Discussion

- Top two prevention strategies reported by **NMQ LBP yes/no**
  - Regularly complete at least 150 minutes per week of moderate-intensity aerobic physical activity
  - Know how to engage the deep core muscles
- Few, if any, prevention strategy responses
  - Worksite-based fitness program was led daily by a facilitator
  - Worksite-based fitness program occurred on company time
  - Ergonomic-related topics discussed during team meetings
- Suggest it is the personal responsibility of the emp rather than shared responsibility of the emp and hospital management to address LBP

Conclusion

- Those who completed more low back pain prevention strategies did not experience less musculoskeletal symptoms than those individuals who completed fewer, if any, prevention strategies
  - Small sample size
  - Relatively low number of best practices completed
- Future research
  - Identify and survey EP/Cath lab professional who regularly complete a relatively high number of prevention strategies
  - Ethnographic research on EP/Cath lab departments which report a low prevalence of musculoskeletal symptoms

Example of a pilot worksite-based fitness program

1. Secure EP/Cath lab senior management support
2. Pre-assessment
3. Implement worksite-based fitness program
4. Promote independent exercise component
5. Discuss ergonomic-related topics during team meetings
6. Post-assessment

Step 1: Secure EP/Cath lab senior management support

- Hospital management believes improvements in the physical conditioning of the physicians and staff will help to prolong their careers
- Customized around the department's specific needs, preferred communication methods, and resources available to the employees to help create a sense of ownership
- Develop strategies to overcome the following MSD risk factors:
  - Limited time to stretch
  - Lack of regular breaks
  - Requirement to keep the body in a sustained forward-flexed posture during surgery

Step 2: Pre-assessment

- Sign release of liability and informed consent forms
- Complete Qualtrics survey used in my dissertation
  - Low back pain and other musculoskeletal symptoms are periodically evaluated in the physicians and staff
- Functional Movement Screening
  - The Functional Movement Screen or another validated screening tool is periodically used to identify faulty movement patterns or muscular imbalances in the physicians and staff

Goals/Objectives

Goals	Objectives
Participation	80% complete NMQ (Dickinson et al., 1992)
Satisfaction	95% select "Strongly Agree" or "Agree" when asked to rate overall satisfaction (Likert Scale) 90% would recommend this program/service to a co-worker (Net Promoter Score)
Health Improvement	NMQ = less "Yeses" T_2/T_2 (27 "Yes" max) FMS = improved score $T_2/T_2/T_3$ (21-point max)
Financial	Purchase exercise equipment & annual Wellbeats memberships

Step 3: Implement worksite-based fitness program

- Lead daily by a facilitator and occur on company-time
- Each class included some or all of the exercises targeting the various muscle groups of the body, including the hands and forearms, upper trunk and shoulder girdle, cervical and lumbar spine, hips, and legs
- Includes strength training exercises (squats, pullups, using exercise bands, etc.)
- Includes stretching exercises (calf stretch, forearm stretch, low back stretch, etc.)
- Know how to engage the deep core muscles to add stability to the spine (i.e. abdominal draw-in maneuver)

Step 4: Promote independent exercise component

- Wellbeats membership for independent exercise option
  - Regularly complete stretching exercises, such as calf stretch, forearm stretch, low back stretch, etc.
  - Regularly complete strength training exercises two or more days/week, such as squats, pullups, using exercise bands, etc.
  - Overall, do you do your fitness program regularly
- Distribute exercise tracker – 2 General Goals
  - Systematically change the number of sets, reps, or weight used in my strength training program from time to time (i.e. periodization)
  - Regularly complete at least 150 minutes per week of MPA, such as brisk walking, bicycling, gardening, mowing the lawn, etc.

Step 5: Discuss ergonomic-related topics during team meetings

- Includes discussion on poor posture(s)
- Includes discussion on stress management
- Includes discussion on active coping strategies (securing social support, turning to religion, active distraction, etc)

Step 6: Post-assessment

- Ideally would like to implement 1 year program
- Functional Movement Screening at 6 month and 1 year mark
  - Low back pain and other musculoskeletal symptoms are periodically evaluated in the physicians and staff
  - The Functional Movement Screen or another validated screening tool is periodically used to identify faulty movement patterns or muscular imbalances in the physicians and staff
- Complete Qualtrics survey used in my dissertation at 1 year mark
  - NMQ asks "Have you at any time in the **last 12 months** had trouble in…" and "Have you at any time during the **last 12 months** been prevented from doing your normal work (at home or away from home) because of the trouble?"

Continuity after 1 Year

- Member of senior management becomes "owner" of the program
- Several EP/Cath lab staff volunteer to be the daily class leader
- These responsibilities are reflected in the annual staff review
- Maintained funding for new exercise equipment and annual Wellbeats memberships
- Complete NMQ annually and FMS semiannually (longitudinal cohort study)
- Expand the program to other departments within the hospital system
  - Radiology
  - Nursing
  - Ergonomics, Safety, Occupational Health, Employee Wellness, etc.

Conclusion

"Spine problems are the scourge of our profession. In my practice alone at least 25% of the cardiologists have had back or neck problems…I have had three back surgeries myself and had to give up doing interventional cardiology several years ago. How many cardiologists are standing in the back of the room during meetings with their leg up against the wall, constantly trying to reposition to prevent sciatic pain, numbness in their legs or arms? How many are running in and out of conference rooms because they can't sit for extended lengths of time? I know I was one of those individuals for several years" (Nagelhout, 2016).

References

Bergeron, J., Wright, D., & Killen, J. (2016). Low back pain among radiologic technologists. *Cath Lab Digest, 24*(6). Retrieved from http://www.cathlabdigest.com/articles/Low-Back-Pain-Among-Radiologic-Technologists

Christensen, W. (2010). Stretch exercises: Reducing the musculoskeletal pain and disc comfort in the arms and upper body of echocardiographers. *Journal of Diagnostic Medical Sonography, 26*(3), 103-114.

Cornelius, K., Turin, F., Wellington, W., & Gallagher, S. (n.d.). *An approach to identify jobs for ergonomic analysis*. Retrieved from https://www.cdc.gov/niosh/mining/UserFiles/work/pdf/AAE.pdf

Dickinson, C., Campion, K., Foster, A., Newman, S., O'Rourke, A., & Thomas, P. (1992). Questionnaire development: An examination of the Nordic musculoskeletal questionnaire. *Applied Ergonomics, 23*(3), 197-201.

Freimann, T., Merisalu, E., & Pasanen, M. (2012). Effects of a home exercise therapy programme on cervical and lumbar range of motion among nurses with neck and lower back pain: A quasi-experimental study. *BMC Sports Science, Medicine & Rehabilitation, 7*(1). doi:10.1186/2052-1847-4-6

Gartley, R., & Prosser, J. (2011). Stretching to prevent musculoskeletal injuries: An approach to workplace wellness. *AAOHN Journal, 59*(6), 247-253. https://doi.org/10.3777/jaohnj.59.6.247

References

Goldstein, J., Balter, S., Cowley, M., Hodgson, J., & Klein, L. (2004). Occupational hazards of interventional cardiologists: Prevalence of orthopedic health problems in contemporary practice. *Catheterization and Cardiovascular Interventions, 63*(4), 418–421. doi:10.1002/ccd.20208

Jaromi, M., Nemeth, A., Kranicz, J., Laczko, T., & Betlehem, J. (2011). Treatment and ergonomics training of work-related lower back pain and body posture problems for nurses. *Journal of Clinical Nursing, 20*(13-14), 1976-1984. doi:10.1111/j.1365-2702.2011.03783.x

Johnson, D. (2011). *Efficacy of a novel thoracolumbar orthosis in reducing lumbar spine loading and muscle fatigue in flexion: A study with weighted garments* (Doctoral dissertation). Retrieved from https://vtechworks.lib.vt.edu/bitstream/handle/10919/31281/Johnson_DA_D_2011.pdf?sequence=1&isAllowed=y

Katz, J. (2006). Lumbar disc disorders and low-back pain: Socioeconomic factors and consequences. *Journal of Bone & Joint Surgery, 88A*(Suppl.), 21-24. https://doi.org/10.2106/JBJS.E.01273

Klein, L., Miller, D., Balter, S., Laskey, W., Haines, D., Norbash, A., ... Goldstein, J. (2009). Occupational health hazards in the interventional laboratory: Time for a safer environment. *Radiology, 251*(3). http://dx.doi.org/10.1148/radiol.2513081738

Lamar, S. (2014). *Investigation of factors associated with prevalence and severity of musculoskeletal symptoms among the workers in a clinical specialties of radiologic technology: An ergonomic and epidemiological approach* (Master's thesis). Retrieved from https://repository.lib.ncsu.edu/bitstream/handle/1840.16/9468.pdf?sequence=1

References

Naughton, D. (2018, August 27). *Back pain: The scourge of the CV profession*. Retrieved from https://www.acc.org/latest-in-cardiology/articles/2018/08/29/13/back-pain-the-scourge-of-the-cv-profession

Occupational Safety and Health Administration. (2013). *Caring for our caregivers: Facts about hospital worker safety*. Retrieved from https://www.osha.gov/dsg/hospitals/documents/1_1_Factbook_508.pdf

Office of Disease Prevention and Health Promotion. (2018). *Physical activity guidelines for Americans* (2nd ed.). Retrieved from https://health.gov/paguidelines/second-edition/pdf/Physical_Activity_Guidelines_2nd_edition.pdf

Smith, K. (2013). Evaluation of a stretching program to increase worker flexibility. *Workplace Health & Safety, 61*(8), 329-332. http://dx.doi.org/10.3928/21650799-20130726-91

Starr, N. (2008). *Analysis of a pre-work stretching program at Crystal Finishing Systems, Inc.* (Masters Thesis). Retrieved from https://core.ac.uk/download/pdf/56781194.pdf

Waddell, G. (2004). *The back pain revolution* (2nd ed.). Edinburgh: Churchill Livingstone.

Wellbeats. (2018). *Our product*. Retrieved from https://wellbeats.com/our-product/